CALIFORNIA DIVISION OF MINES AND GEOLOGY
FAULT EVALUATION REPORT FER-188

PISGAH, BULLION, AND RELATED FAULTS
SAN BERNARDINO COUNTY, CALIFORNIA
Supplement No. 1

by
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August 5, 1987

Since completion of FER-188 (Hart, 1987), three references were obtained that were not previously reviewed. These references, by Wise (1966, 1969) and Wilbur (1980), contain information on the Pisgah fault and on the relative ages of young volcanic units that are offset by the fault. While these references do not change the recommendations of FER-188, they provide additional data on fault recency and slip-rates for the Pisgah fault..

Wise (1966) mapped the Pisgah and Sunshine Cone lava fields at a scale of 1:24,000. He refers to other unpublished reports by Garawecki (1964), Dibblee (1965), Fischer and others (1965), and Altenhofen and others (1965), which were not obtained for this review. According to Wise, the Pisgah lava field was formed in "three distinct eruptive phases, each separated by a fairly long period of time." He mapped both lava and cinder deposits in each eruptive phase and recognizes three relative ages. Although he does not estimate an absolute age, he clearly shows the youngest lava unit to be faulted. His mapping in the Hector and Sunshine Peak quadrangles is similar to Hart (1987) and Morton and others (1980), but differs in detail. His data were later partly published by Wise (1969). In that report he identifies five flow units and again shows the youngest flow to be faulted.

Wise (1966) also mapped the Sunshine cone lava field in the Sunshine Peak and Lavic Lake quadrangles. Here he identified two flows--the older Lavic flow and the younger Sunshine Cone flow. Wise believed that the older flow predated all of the Pisgah flows and that the younger flow occurred between the first and second eruptive phases of the Pisgah flows. (However, a brief review of the aerial photographs suggests that the morphologic features of all of the Pisgah flows are better preserved and probably younger than the youngest Sunshine flow.) Wise shows the Pisgah fault to offset the Lavic and Sunshine Cone flows, as well as the cinder cover associated with the Lavic flow. His mapping indicates that the older cinder cone deposits are offset right-laterally about 600 meters. The northern margin of the Sunshine Cone flow is shown to be offset right-laterally a minimum of 90 meters, although the northern edge of the unit is overlain by alluvium west of the fault. Wise shows the southern margin of this flow to be offset about 100 to 150 meters.

Wilbur (1980) studied the Sunshine Cone and several other lava fields in order to compare the geomorphic, petrologic, and other characteristics of several Quaternary basalt flows in the central Mojave Desert. He mapped the younger Sunshine Cone and older Lavic flows and associated pyroclastic deposits at a scale of 1:24,000 on a planimetric base map. His mapping (see Figure 1) is similar to that of Wise (1966), but differs in detail. Wilbur considered the Sunshine flow to be older than any of the Pisgah flows, based on morphologic degradation of surface volcanic features. He stated (p. 124) that the Pisgah

flows were "fresh enough to be considered Recent" (i.e. Holocene). Wilbur provides a K-Ar date of 0.138±.018 m.y. for the Sunshine Cone flow, but he neither states the source of this date or discuss its probable limitations. The Lavic Flow (Figure 1) was considered to be morphologically similar to the Malpais lava field 12 miles to the west, which yielded a K-Ar date of 0.935±.035 m.y. Again he does not discuss the source of this date or which of the several Malpais flows was sampled. Wilbur considered the Malpais and Lavic flows to have about the same degree of "morphological decomposition" and about the same age.

Wilbur's map of the Pisgah fault (Figure 1) is similar to others, but differs in detail. He estimates that the Lavic flow is offset 0.5 km right-laterally (Wilbur, p. 57). However, his map indicates about 0.8 km of offset for the northern margin of the flow. He also shows the older pyroclastic deposits associated with the Lavic flow to be offset 0.7 to 0.8 km (Figure 1). Wilbur states that there is no apparent lateral offset of the Sunshine Cone flow (only vertical displacement). This is not supported by his mapping, which shows the north margin of the Sunshine flow to be apparently offset at least 0.6 km in a right-lateral sense. He shows the southern margins of the Sunshine Cove flow to be offset about 100 meters.

DISCUSSION AND CONCLUSIONS

Wise (1966, 1969) and Wilbur (1980) provide considerable data on the units and relative ages of the Pisgah and Sunshine Cone lava fields that should be useful in determining recency of activity and slip rates for the Pisgah fault. However, their interpretations are sufficiently different that it is difficult to draw firm conclusions regarding late Quaternary activity of the fault.

Recency of Faulting

Wise clearly shows the youngest flow of the Pisgah field to be faulted. Wilbur felt that the flows could well be Holocene in age. While Wilbur raised questions as to the evidence of surface faulting of the Pisgah flows, others consider the alignment of scarps and linear ridges to be clear evidence of post-Pisgah faulting (see Hart, 1987).

Slip Rates

Data presented by Wise and Wilbur raise questions regarding the tentative late Quaternary slip-rate of 1.4 mm/yr suggested by Hart (1987) at X-X'. For one thing, Wilbur infers an age of nearly 1 m.y. for the Lavic flow, whose northern boundary appears to be offset about 0.8 km (Fig. 1). This would imply a slip-rate of 0.8 to 0.9 mm/yr. However, he states that the Lavic flow is offset only 0.5 km! The pyroclastic deposit associated with the Lavic flow also is shown by Wilbur to be offset 0.7 to 0.8 km (Fig. 1), which would give a comparable slip-rate. Mapping by Wise shows apparent offsets for these same flow and pyroclastic deposits to be about 0.7 km and 0.6 km, respectively.

Unfortunately, the northern margin of the younger Sunshine flow is shown to be apparently offset a minimum of 0.6 km based on Wilbur (see Fig. 1). Although he states that the unit is not laterally offset, this is not consistent with his mapping. If the Sunshine lava flow is really 138,000 ybp, then a slip-rate of about 4 mm/yr can be calculated. In contrast, Wise (1966) shows

this same contact offset about 90 meters, which would suggest a much lower slip-rate. In addition, Wilbur and Wise both show the southern margins of the Sunshine Cone flow to be offset about 100 meters or so. This would give a slip-rate of a little more than 0.5 mm/yr.

The 1 mm/yr rate suggested for the southern margin of the Sunshine Cone lava field (y-y' of Hart), which is south of the area mapped by Wise and Wilbur, also must be questioned. It is not clear if this basalt flow of Dibblee (1966) correlates with the Lavic or Sunshine flow. Morphologically it appears on air photos to be comparable to the Lavic flow, but this correlation must be regarded as tentative. If the unit is correlative, then a tentative slip-rate of a little more than 0.5 mm/yr is determined based on Dibblee's mapping (0.5 km of offset) for this segment of the Pisgah fault.

While the work of Wise (1966, 1969) and Wilbur (1980) sheds additional light on the ages and distribution of volcanic units offset by the Pisgah fault, additional work is needed to confidently establish late Quaternary slip-rates for the fault. However, the Pisgah fault near Sunshine Cone now appears to have a post-Lavic slip rate of about 0.8 mm/yr and a post-Sunshine Cone flow slip rate of at least 0.5 mm/yr. These slip rates are reasonably consistent with each other. Based on the tectonic geomorphic features observed in the area (Hart, 1987), a slip-rate of 0.8 mm/yr is now preferred.

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